Technical Report #12

Stream Temperature Considerations in the Development of Plum Creek's Native Fish Habitat Conservation Plan

Overview

Many scientific studies have proven that streamside timber harvest can increase stream temperatures. The primary reason is that harvest removes shading from the stream and sunlight reaches the surface of the water, warming the stream. Native salmonids, particularly bull trout, are sensitive to increases in stream temperature. The purpose of Technical Report #12 is to evaluate stream temperature features that must be considered in the development of Plum Creek's Native Fish Habitat Conservation Plan (NFHCP).

Key Points

Five key subjects were addressed in this report to form the basis of the NFHCP:

1. Review of temperature requirements of native fish in the Project Area, including bull trout
2. Review of winter conditions on trout in ice-covered streams
3. Discussion of the potential influence of small streams on water temperature in downstream fish-bearing waters
4. Results of a study of canopy cover before and after timber harvest along 10 streams in Montana and Idaho
5. Development of a predictive stream temperature model for western Montana and northern Idaho

Supporting Technical Information

Managing riparian areas requires a thorough understanding of what controls stream temperature in a riparian system and the temperature needs of the native fish. Results of the temperature study are summarized below.

Temperature Requirements of Native Fish

Adult bull trout rear and migrate within a wide range of temperatures (4 to 20.5°C). This range is similar to those observed during steelhead migration (less than 21°C). Bull trout spawning temperatures range from 4 to 12°C, which is similar to other fall-spawning salmonids in the Project Area. Incubation temperatures for chinook salmon, a fall spawner, range from 5 to 14.4°C. In comparison, incubation temperatures for bull trout range from 1 to 6°C. Juvenile bull trout can rear within a wide range of water temperatures (4 to 20.5°C); however, optimal temperatures appear to fall between 10 and 15°C. This optimal temperature range appears to be cooler and narrower than for other salmonids in the Project Area. For example, steelhead, rainbow trout, and chinook all have optimal temperatures that range from 10°C to well above 15°C. In general, preferred temperatures for native salmonids in the Project Area are similar to the optimal temperatures for bull trout.

Winter Conditions on Trout in Ice-Covered Streams

The behavior, habitat use, and survival of trout at cold temperatures in winter differs from that during warmer, ice-free periods. During the winter, trout occupy stream locations with low water velocities (less than 15cm/s) and extensive cover, including clean substrate, large woody debris, undercut banks, deep pools, beaver ponds, and side channels. These areas can be affected by improper timber harvest, which can reduce or damage stream pools and banks and limit the influx of large woody debris. Removing stream shade may also make streams colder during winter, thus possibly increasing ice formation in streams.

Influence of Small Streams on Fish-Bearing Waters

Small, non fish-bearing, perennial streams occupy a large part of the drainage network in the NFHCP Project Area. Research suggests these streams could influence summertime water temperatures in downstream fish-bearing reaches if they add more than 20 percent of the streamflow to the fish-bearing reach. Also, the temperature of these small streams can change significantly in 500 feet. As such, an effective management strategy for controlling temperatures in downstream fish-bearing waters would be to provide sufficient shading in the lower 500 feet of these streams before they enter a fish-bearing stream.

Canopy Cover Study

Canopy cover and riparian stand conditions for nine streams in western Montana and one stream in northern Idaho were examined before and after timber harvest in 1997. Canopy cover reduction after harvest ranged from 0 to 13 percent. Of the ten sites measured, four had statistically significant decreases in canopy cover. With these levels of canopy cover change, stream temperature changes are expected to be small (less than $1^{o}C$) based on the predictive model developed during this study.

Predictive Stream Temperature Model

Predictive models can be used to describe the range of current conditions in the Project Area, estimate maximum stream temperatures under natural (or potential) conditions, or develop and test hypotheses as part of research and adaptive management. The models developed predict maximum summer water temperatures as a function of canopy cover, elevation, and an index of climatic conditions.

Conclusion and Implications

Results of this technical report will be used as a basis for the conservation commitments in Plum Creek's NFHCP. Although stream temperature has been studied in Washington and Oregon for over 25 years, little research has been conducted in the northern Rocky Mountains. Areas of uncertainty, such as specific temperature requirements of bull trout, are currently being explored in laboratory studies. These uncertainties will be addressed through an adaptive management process developed as part of the NFHCP.